Brüel & Kjær

Precision Integrating Sound Level Meter Type 2230

Valid from serial no. 1028340

037-0539

Service

Precision Integrating Sound Level Meter Type 2230

Valid from serial no. 1 028 340

037-0539

Consisting of:

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Updating

Due to the constant progress in technology the instrument will from time to time be brought up to date in order to provide continuously improved performance.

For this reason there may be small variations between the instrument and the Service Instruction.

However, the local Service Representative is in possession of all informations regarding any change that has been made.

Trouble Shooting

If any fault should occur, check the instrument according to the Checking Procedure.

The Checking Procedure is divided up into sections, where each section will refer to a subsection in the Service Instruction corresponding to a specific part of the instrument.

The subsection in the Service Instruction will normally consist of a Block Diagram, a Technical Description, an Adjustment Procedure and a Simplified Diagram where the test points are identified.

Before correcting any apparent deviation make sure that the measuring instrument has tolerances small enough not to affect the measurement.

When a fault has been traced and corrected, the voltages and adjustments influenced by the correction must be rechecked. The complete instrument should then be tested to make sure that all basic functions are operative.

The tolerances given in these notes are intended for use as guide for adjustments.

Many instruments have various aids to be used when trouble shooting or adjustment is carried out. They are not necessarily mentioned in the Service Instruction.

The local Service Representative is in possession of information regarding these aids.

Spare Parts

Please state type and serial number of the instrument when ordering spare parts.

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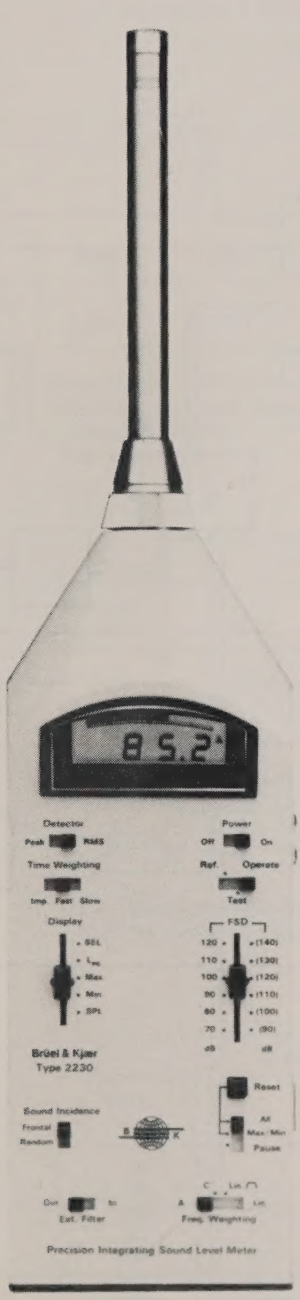
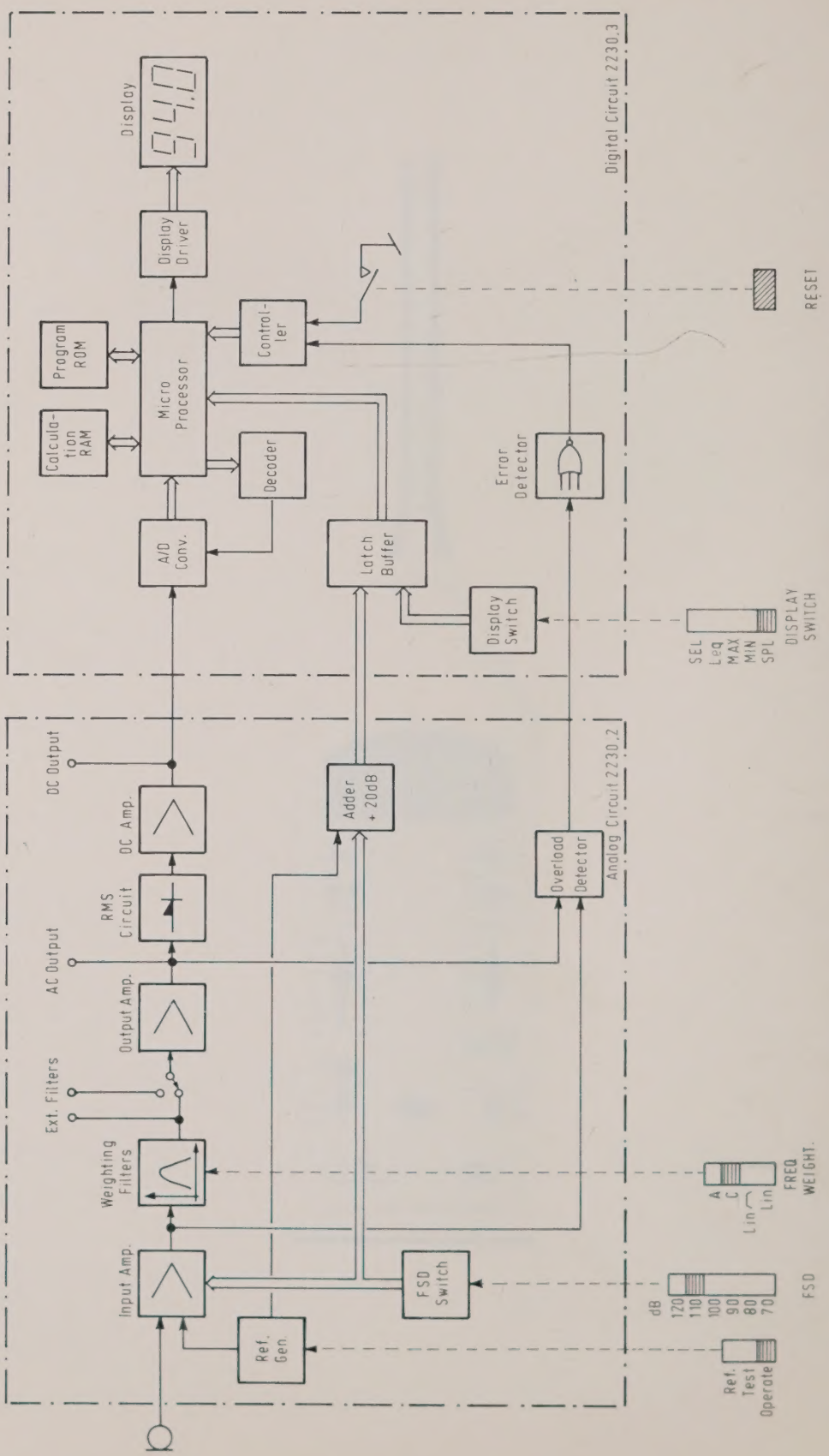

85.2
Detector
Peak
RMS
Power
Off
On
Time Weighting
Imp.
Fast
Slow
Ref.
Operate
Test
Display
SEL
Max
Min
SPL
FSD
120
110
100
90
80
70
(140)
(130)
(120)
(110)
(100)
(90)
dB
Brüel & Kjær
Type 2230
Reset
Sound Incidence
Frontal
Random
Max/Min
Pause
Ext. Filter
Freq. Weighting
Precision Integrating Sound Level Meter


Digital Circuit 2230.3
Display
Display Driver
Program ROM
Calculation RAM
Micro Processor
Controller
Decoder
A/D Conv.
Latch Buffer
Error Detector
Display Switch
RESET
SEL
Leq
MAX
MIN
SPL
DISPLAY SWITCH
Analog Circuit 2230.2
DC Output
DC Amp.
RMS Circuit
AC Output
Output Amp.
Ext. Filters
Weighting Filters
Input Amp.
Ref. Gen.
FSD Switch
Adder +20dB
Overload Detector
A
C
Lin
Lin
FREQ WEIGHT.
dB
120
110
100
90
80
70
FSD
Ref.
Test
Operate

Sensitivity

POWER: "On"
REF., TEST, OPERATE: "Operate"
FSD: "100"
FREQ. WEIGHTING: "Lin /‾\"
EXT. FILTER: "Out"
SOUND INCIDENCE: "Frontal"
DISPLAY: "SPL"
TIME WEIGHTING: "Fast"
DETECTOR: "RMS"
ALL–MAX/MIN–PAUSE: "All"

Input signal through a 15 pF capacitor (Adaptor Type WA 0302) to Preamplifier ZC 0020 input: 50 mV, 1 kHz.

Check the Display reading: 94,0.
If necessary adjust "Sens. Adj." on the right side of the instrument.

If not consult 2230.2 Analog Circuit.

Input Voltage	0 dB	–10 dB	–20 dB	–30 dB	–40 dB	–50 dB
DC Output Voltage	3,000 V	2,500 V	2,000 V	1,500 V	1,000 V	0,500 V

Linearity

FSD to "120"

Input signal 1 kHz corresponding to 3,000 V at "DC Output".
Decrease the Input voltage in 10 dB step and check that the DC Output decreases by 500 mV.
Tolerance: ± 30 mV.

	Display reading	
Freq. Hz	Lin /‾\	Lin
10	87,9 ± 2,0	93,4 ± 0,5
20	93,1 ± 0,5	93,7 ± 0,3
40	93,9 ± 0,3	93,9 ± 0,3
80	94,0 ± 0,3	94,0 ± 0,3
1,0 k	94,0	94,0
2,5 k	94,0 ± 0,3	94,0 ± 0,3
5,0 k	94,0 ± 0,3	94,0 ± 0,3
10 k	94,0 ± 0,3	94,0 ± 0,3
20 k	93,9 ± 0,3	93,5 ± 0,5

Frequency Response

FSD to "100"

Input signal 1 kHz corresponding to 94,0 on the Display.
Check the frequency response according to the table above.

	Display reading		
Freq. Hz	A	C	Tolerance + dB –
10		79,7	1,5 2,0
20	43 5	87,8	1,0 1,0
40	59,4	92,0	0,5 0,5
80	71,5	93,5	0,5 0,5
160	80,6	93,9	0,3 0,3
315	87,4	94,0	0,3 0,3
1,0 k	94,0	94,0	0 0
2,5 k	95,3	93,7	0,3 0,3
5,0 k	94,5	92,7	0,5 0,7
10 k	91,5	89,6	1,0 1,5
20 k	84,7	82,8	1,0 1,5

Weighting Filters

FREQ. WEIGHTING to "A" or "C"

Input signal 1 kHz corresponding to 94,0 on the Display.
Check the frequency response according to the table above.

If not consult 2230.2 Analog Circuit.

Freq. kHz	Display reading
1,0	94,0
2,5	94,3 ± 0,3
5,0	95,2 ± 0,5
10	96,8 ± 0,5
20	98,2 ± 0,5

Random Freq. Response

Input signal 1 kHz corresponding to 94,0 on the Display.
Check the frequency response according to the table above.

SOUND INCIDENCE to "Random"
FREQ. WEIGHTING to "Lin/⁀\ "

L_{eq} SEL

Input signal 1 kHz corresponding to 94,0 on the Display.

SOUND INCIDENCE to "Frontal"
FSD to "110"

DISPLAY to "L_{eq}"

Activate "Reset"
Check the Display reading: 94,0 ± 0,1.

DISPLAY to "SEL"

Activate "Reset" and let the L_{eq} run for exactly 10 s.
Check that the Display reads: 103,9 and is increasing every second the next 10 seconds.

TIME WEIGHTING to "Imp or Slow"

Check that an arrow occurs to the right of the Display.

Notice: This arrow can be removed by removing the jumper "1" near the "Peak - RMS" switch.

If the above cannot by fulfilled consult item 2230.3 Digital Circuit.

Overload

Input signal: 1,05 V, 1 kHz.

DISPLAY to "SPL"
TIME WEIGHTING to "Fast"

Check that the Overload indication on the Display does not light.
Increase the Input voltage to: 1,12 V.
Check that the Overload lights: ± 0,05 V

If not consult 2230.2 Analog Circuit.

Test

Check that all digits and Signs on the Display lights.

REF., TEST, OPERATE to "Test"

REF.

Check the Display reading: 94,0 ± 0,1.

REF. TEST, OPERATE to "Ref."

Calibration

Mount the Preamplifier ZC 0020 and the Microphone Type 4155.

REF. TEST. OPERATE to "Operate"

Check by means of a Sound Level Calibrator or a Pistonphone that the calibration is correct.
If necessary adjust "Sens. Adj.".

Detector Balance

Input signal to "Ext. Filter" socket J201 pin 1: 633 mV, 1 kHz.

POWER: "On"
REF., TEST, OPERATE: "Operate"
FSD: "110 dB"
FREQ. WEIGHTING: "Lin ⌒"
EXT. FILTER: "In"
SOUND INCIDENCE: "Frontal"
DISPLAY: "SPL"
TIME WEIGHTING: "Fast"
DETECTOR: "RMS"
ALL-MAX/MIN-PAUSE: "All"

Check at ZE 0410 pin 15 that the curves are equal.
If necessary adjust P205.

Change the input voltage to 2 mV.
Set P206 to middle position.

Check the Display reading: "60,0".
If necessary adjust P207.

Check the "DC Output" voltage: 500 ± 2 mV.
If necessary adjust P209.

Change the input voltage to: 633 mV.
Check the "DC Output" voltage: 3000 ± 2 mV.
If necessary adjust P208.

Check the Display reading: "110".
If necessary adjust P103. (Ref. to Digital Circuit 2230.3).

Repeat the above adjustments until all are within the tolerances.

Preamp Offset

Short circuit the Preamplifier ZC 0020 input to ground through a 15 pF capacitor (Adaptor Type WA 0302).

FSD to "70 dB"
EXT. FILTER to "Out"

Check the voltage at the output of the Preamplifier on the point C205, 206: 0 ± 20 mV DC.
If necessary adjust P201.

FSD to "110"

Input signal through the adaptor to the ZC 0020 input: 50 mV, 1 kHz.

Check the Display reading: "94,0".
If necessary adjust P206.

Weighting Network

Check the Display reading: "94,0".
If necessary adjust P202.

FREQ. WEIGHTING to "C"

FREQ. WEIGHTING to "A"

Check the Display reading: "94,0".
If necessary adjust P203.

Overload

Input signal to "Ext. Filter" socket J201 pin 1: 2,2 V, 1 kHz.

EXT. FILTER to "In"
FREQ. WEIGHTING to "Lin ⌒"

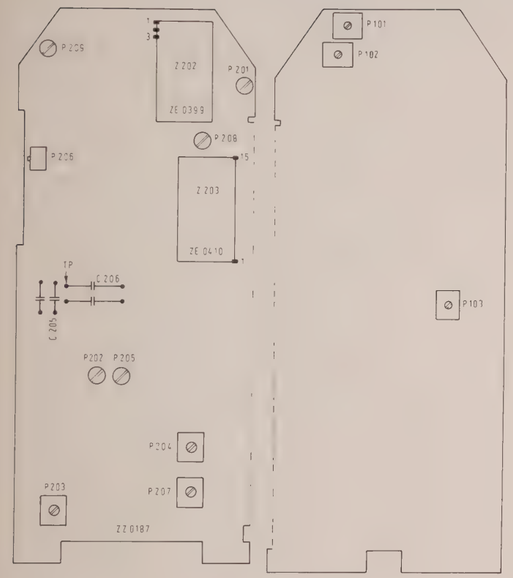
Check that the Overload arrow lights within ± 0,2 dB.
If necessary adjust P204.

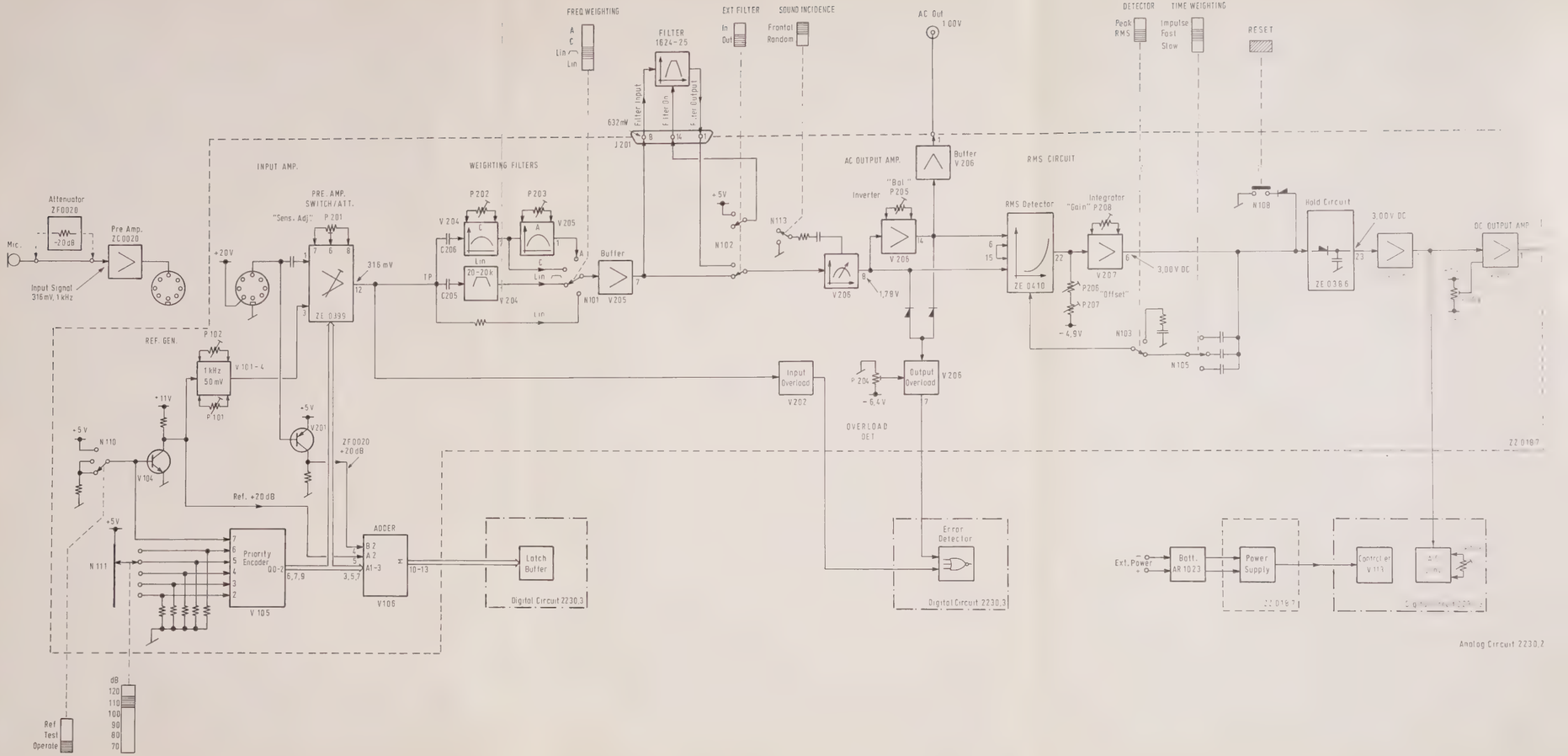
Reference Generator

Check the frequency at the Ref. input to ZE 0399 pin 3: 1000 ± 1 Hz.
If necessary adjust P101.

REF., TEST, OPERATE to "Ref."
EXT. FILTER to "Out"

Check the Display reading: "94,0".
If necessary adjust P102.

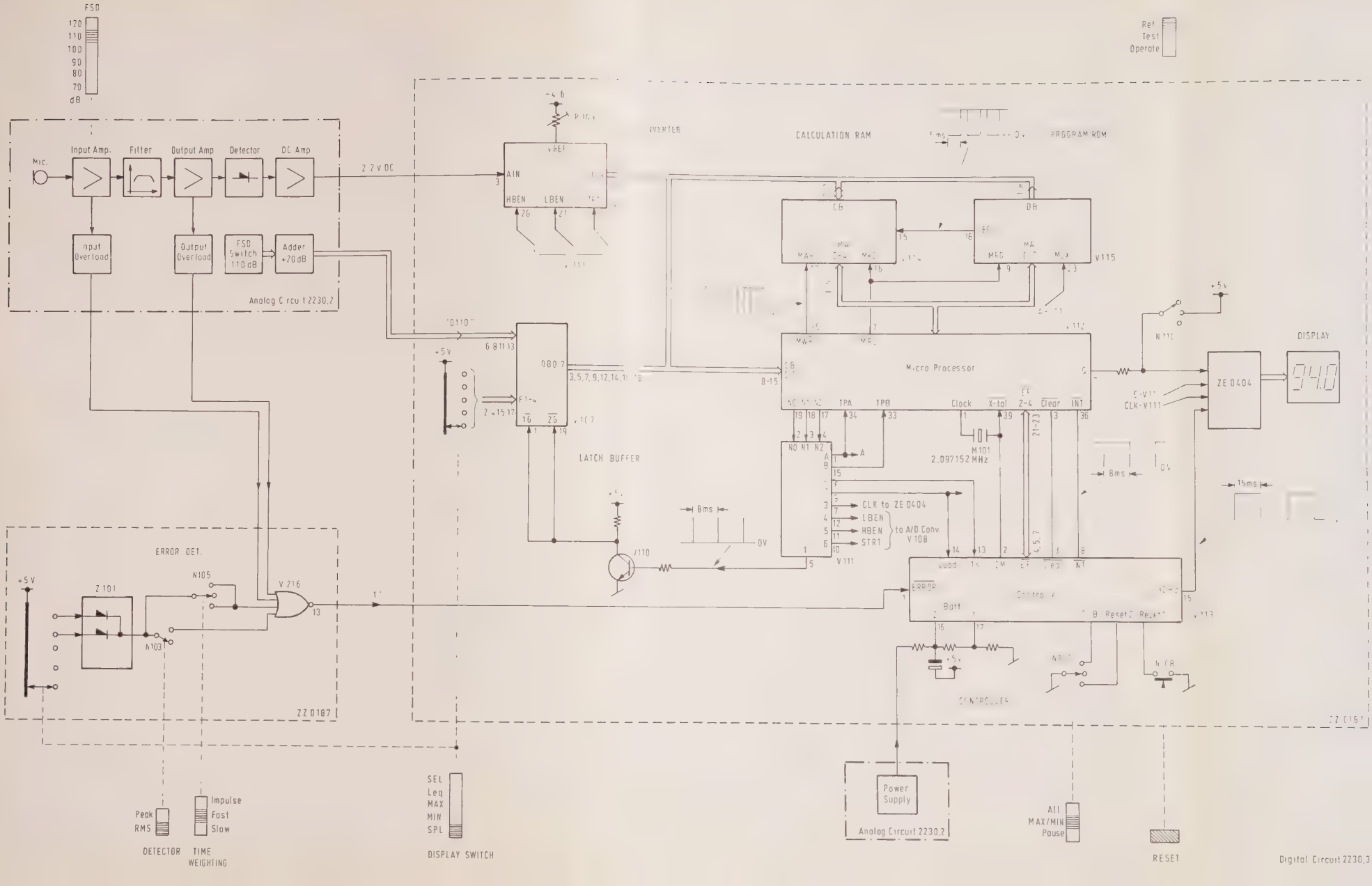

P205
Z202
ZE 0399
P201
P101
P102
P208
P206
Z203
ZE 0410
TP
C206
C205
P202
P205
P204
P207
P203
P107
ZZ 0187

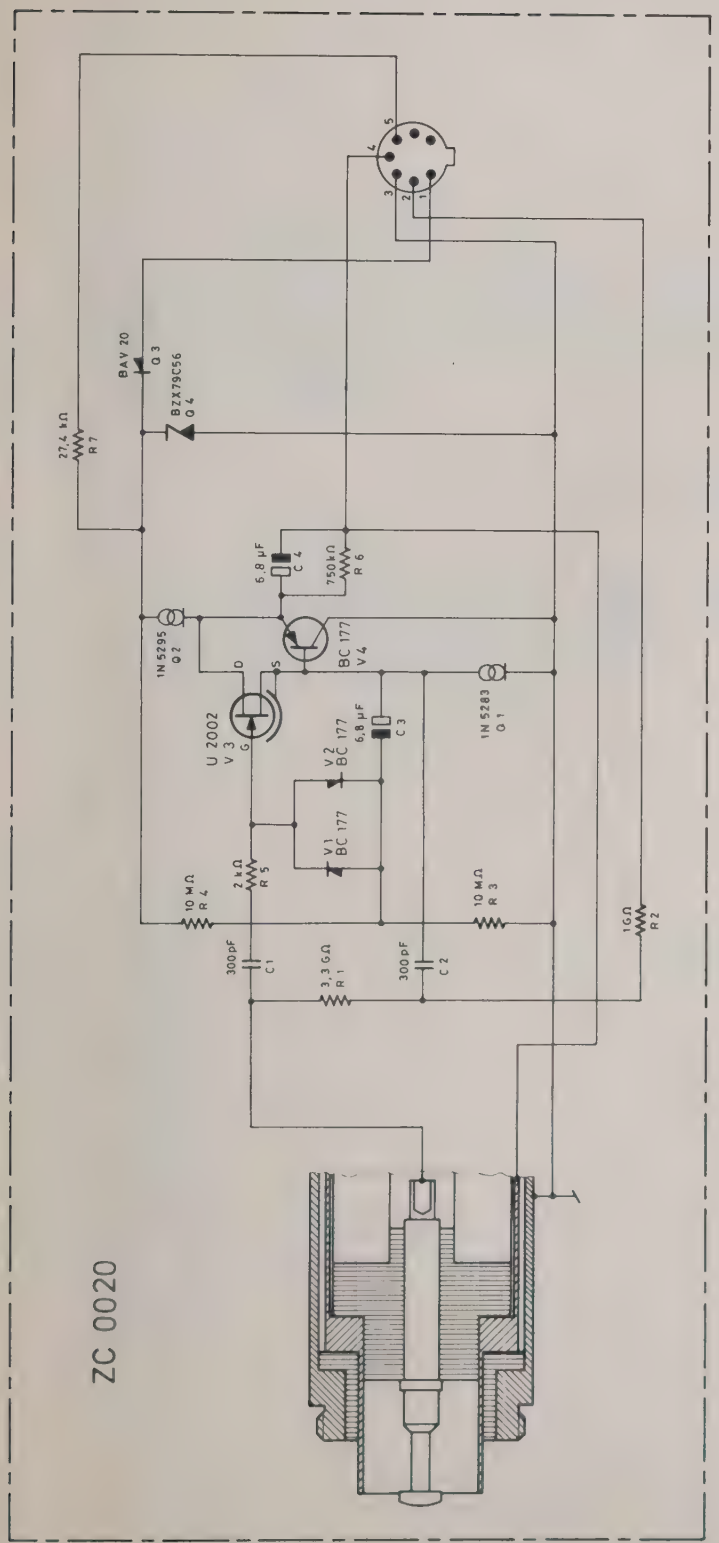

FREQ.WEIGHTING
A
C
Lin
Lin
FILTER
1624-25
EXT.FILTER
In
Out
SOUND INCIDENCE
Frontal
Random
AC Out
1.00V
DETECTOR
Peak
RMS
TIME WEIGHTING
Impulse
Fast
Slow
RESET
632mV
Filter Input
Filter Out
J201
INPUT AMP.
Attenuator
ZF0020
-20dB
Mic.
Pre Amp.
ZC0020
Input Signal
316mV, 1kHz
PRE. AMP.
SWITCH/ATT.
"Sens. Adj."
P201
+20V
316 mV
TP
ZE 0399
WEIGHTING FILTERS
P202
P203
V204
V205
C206
C205
20-20k
Lin
Buffer
V205
N101
N102
+5V
N113
AC OUTPUT AMP.
Inverter
"Bal."
P205
V206
Buffer
V206
RMS CIRCUIT
RMS Detector
ZE 0410
Integrator
"Gain" P208
V207
P206
"Offset"
P207
-4.9V
3.00V DC
N108
Hold Circuit
ZE 0386
3.00V DC
DC OUTPUT AMP.
1.78V
N103
N105
REF. GEN.
1kHz
50mV
V101-4
P102
P101
+11V
+5V
N110
V104
V201
ZF0020
+20dB
Ref. +20dB
Input
Overload
V202
P204
-6.4V
Output
Overload
V206
OVERLOAD
DET.
ZZ 0187
+5V
N111
Priority
Encoder
Q0-2
V105
6,7,9
ADDER
B2
A2
A1-3
V106
3,5,7
10-13
Latch
Buffer
Digital Circuit 2230.3
Error
Detector
Digital Circuit 2230.3
Ext. Power
Batt.
AR 1023
Power
Supply
ZZ 0187
Control
V 113
Digital Circuit 2230.3
Ref
Test
Operate
dB
120
110
100
90
80
70
FSD
Analog Circuit 2230.2

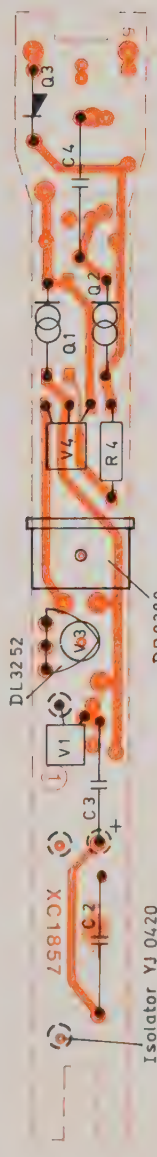
Description

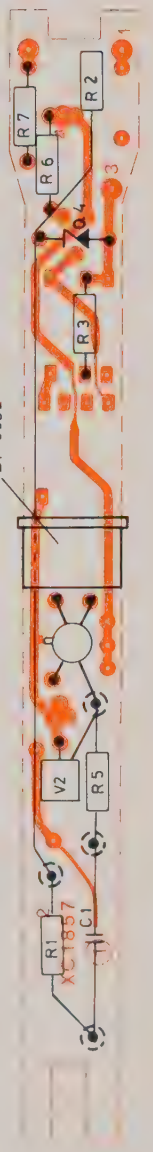
The DC Output from the Analog Circuit is fed to the A/D Converter V108. The Converter works as a Successive Approximation Converter which means that the 1 of the 10 bits output is set when the DC voltage is higher than the half of the Converter voltage. Next bit is set if the voltage is higher than the upper half of the half voltage and so on.

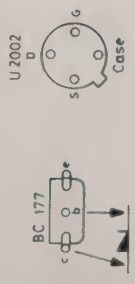
The Microprocessor, which has 8 inputs, first ask for the two M. Sign. bit and store then in the RAM V114. Then the eight L. sign. bits are transfered to the RAM. The result is calculated with a speed of 128 calculations in a second. In the calculation the Data from the Latch Buffer V107 are used as well, telling the Attenuator positions and the position of the Display Switch. Then the result is fed in serial to the Display Driver and to the Display. The Display column is updated 64 times in a second and the Digits every second. The ROM V115 contains the program used for the Micro Processor, and the Controller V113 controls the Reset, Error and Battery conditions.

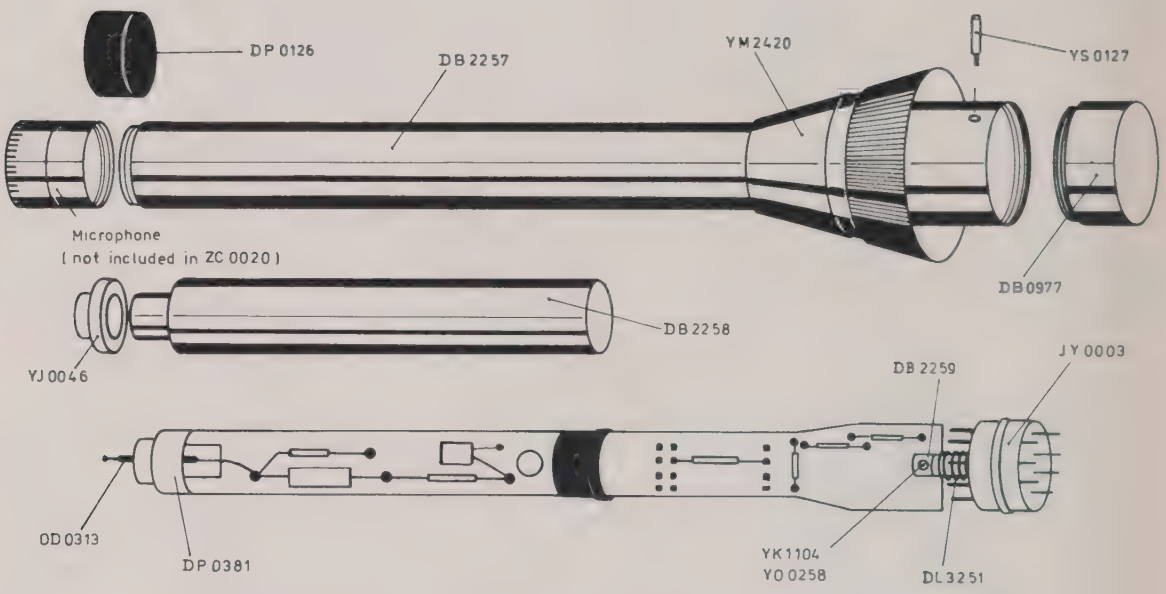

FSD
120
110
100
90
80
70
dB
Ref
Test
Operate
Input Amp.
Filter
Output Amp
Detector
DC Amp
Mic.
2.2 V DC
Input Overload
Output Overload
FSD Switch 110 dB
Adder +20 dB
Analog Circuit 2230.2
INVERTER
CALCULATION RAM
PROGRAM ROM
AIN
HBEN
LBEN
"0110"
Micro Processor
TPA
TPB
Clock
X-tal
Clear
INT
M101
2.097152 MHz
LATCH BUFFER
CLK to ZE 0404
LBEN
HBEN
STRT
to A/D Conv. V 108
ZE 0404
DISPLAY
CLK-V111
8ms
15ms
0V
+5V
ERROR DET.
Z 101
N105
N103
V 216
ZZ 0187
Batt
Reset
Power Supply
Analog Circuit 2230.2
SEL
Leq
MAX
MIN
SPL
DISPLAY SWITCH
Peak
RMS
DETECTOR
Impulse
Fast
Slow
TIME WEIGHTING
All
MAX/MIN
Pause
RESET
Digital Circuit 2230.3


ZC 0020
BAV 20
Q 3
BZX79C56
Q 4
27,4 kΩ
R 7
6,8 µF
C 4
750kΩ
R 6
1N 5295
Q 2
BC 177
V 4
U 2002
V 3
V 2
BC 177
6,8 µF
C 3
1N 5283
Q 1
V 1
BC 177
2 kΩ
R 5
10 MΩ
R 4
10 MΩ
R 3
1GΩ
R 2
300pF
C 1
3,3 GΩ
R 1
300pF
C 2


Q3
C4
Q2
Q1
V4
R4
DL3252
V3
V1
C3
C2
XC1857
Isolator YJ 0420
Rivet YN 0016

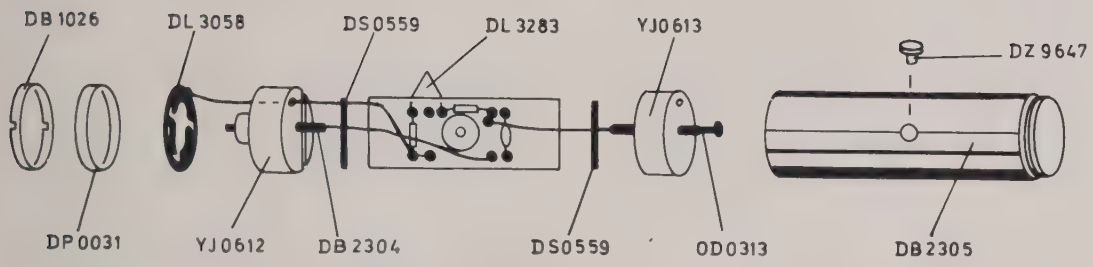

DP 0502
R7
R6
R2
Q4
R3
V2
R5
R1
C1
XC1857

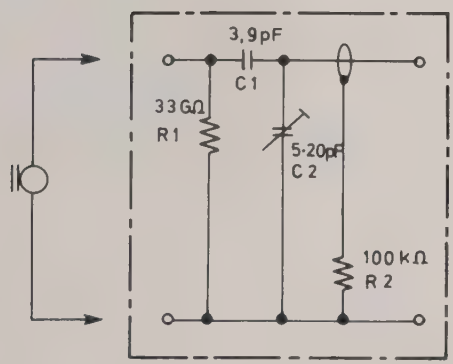

U 2002
D
G
S
Case
BC 177
B
C
E
V1, V 2

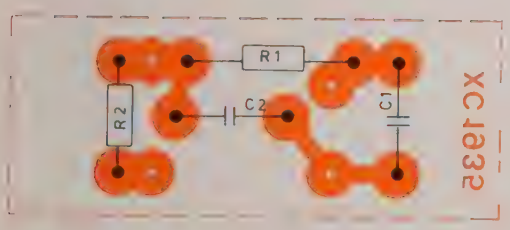


C 1,2	Glass	5%	300 pF/300 V	CG 0002
C 3	Tantalum		6,8 µF/6 V	CF 0006
C 4	-		6,8 µF/35 V	CF 0002
Q 1	Current reg.	1N5283	0,22 mA	QV 6001
Q 2		1N5295	0,82 mA	QV 6002
Q 3	Si.	BAV20	150 V/200 mA	QV 0249
Q 4	Ze.	BZX79C56	53-60 V/0,25 W	QV 1327

R 1	Carbon	1/4 W	20%	3,3 GΩ	RH 0021
R 2	-	-	-	1,0 GΩ	RH 0906
R 3,4	Metal	-	1%	10,0 MΩ	RH 7100
R 5	-	-	-	2,00 kΩ	RF 3200
R 6	-	-	-	750 kΩ	RF 4750
R 7	-	-	-	27,4 kΩ	RF 4274
V 1,2	Silicon			BC177BP	VB 0148
V 3	FET			U2002	VB 1037
V 4	Silicon			BC177BP	VB 0148
	Printed Circuit Board				XC 1857

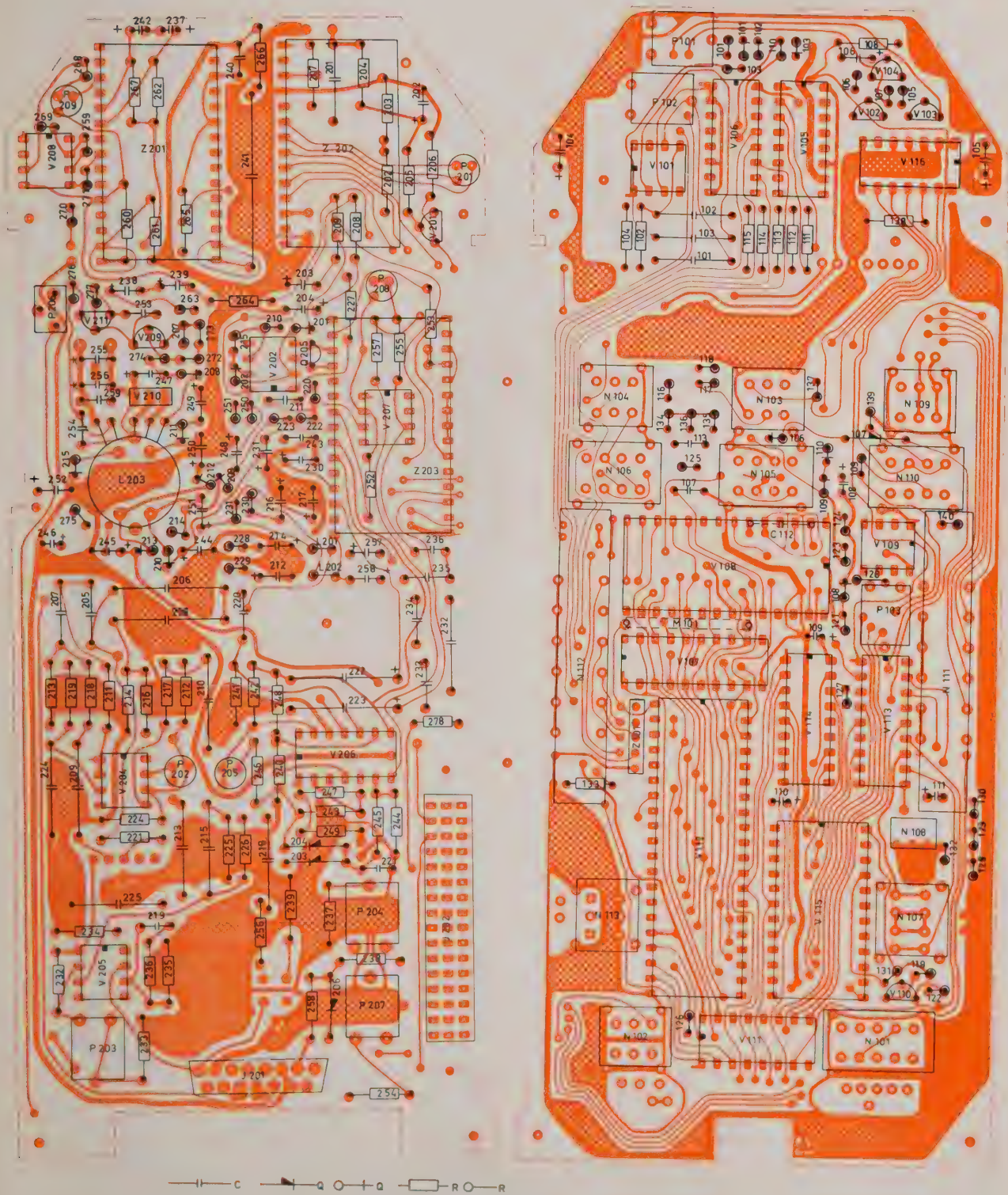






C 1	Ceramic			3,9 pF/250 V	CK 0391
C 2	Variable			5-20 pF	CV 0060
R 1	Carbon	1/8 W	30%	33 GΩ	RH 0924
R 2	-	o,1 W	10%	100 kΩ	RA 0057
	Printed Circuit Board				XC 1935

LAYOUT DIAGRAM



Viewed from the component side

PARTS LIST

C 101	Polystyrene	1%	2 nF/63 V	CT 1123
C 102,103	-	1%	1 nF/63 V	CT 1132
C 104,105	Electrolytic		6,8 µF/16 V	CE 0358
C 106	-		2,2 µF/25 V	CE 0485
C 107	Ceramic		680 pF/400 V	CK 2682
C 108,109	Tantalum		10 µF/16 V	CF 0059
C 110	-		1 µF/35 V	CF 0062
C 111	-		0,33 µF/35 V	CF 0067
C 112	Ceramic		10 nF/30 V	CK 4101
C 113	-		120 pF/400 V	CK 2122
C 201	Tantalum		1 µF/35 V	CF 0062
C 202	Electrolytic		10 µF/25 V	CE 0489
C 203,204	-		47 µF/6 V	CE 0219
C 205	Polycarbonate		0,22 µF/100 V	CS 0389
C 206	-	2%	0,22 µF/63 V	CS 0801
C 207	-		0,22 µF/100 V	CS 0389
C 208	-	2%	0,22 µF/63 V	CS 0801
C 209,210	Polystyrene	1%	560 pF/63 V	CT 1122
C 211	Ceramic		1 nF/400 V	CK 3101
C 212	Electrolytic		15 µF/16 V	CE 0356
C 213	Polystyrene	1%	5,1 nF/63 V	CT 1179
C 214	Electrolytic		15 µF/16 V	CE 0356
C 215	Polystyrene	1%	5,1 nF/63 V	CT 1179
C 216,217	Electrolytic		15 µF/16 V	CE 0356
C 218	Polystyrene	1%	5,1 nF/63 V	CT 1179
C 219	Ceramic		470 pF/400 V	CK 2470
C 220	Polyester		0,15 µF/100 V	CS 0453
C 221	Ceramic		470 pF/400 V	CK 2470
C 222,223	Tantalum		15 µF/20 V	CF 0024
C 224,225	Polystyrene	1%	560 pF/63 V	CT 1122
C 230,231	Electrolytic		47 µF/6 V	CE 0219
C 232	Polyester		1 µF/100 V	CS 0445
C 233	-	5%	0,1 µF/100 V	CS 0450
C 234	-	5%	22 nF/250 V	CS 0449
C 235	-	5%	33 nF/250 V	CS 0451
C 236	Ceramic		1,8 nF/400 V	CK 3181
C 237	Tantalum		0,68 µF/35 V	CF 0058
C 238,239	Electrolytic		47 µF/6 V	CE 0219
C 240	-		15 µF/16 V	CE 0356
C 241	Polystyrene	1%	47 nF/63 V	CT 1521
C 242	Tantalum		0,68 µF/35 V	CF 0058
C 243	Ceramic		10 nF/30 V	CK 4101
C 244	Electrolytic		1 µF/40 V	CE 0483
C 245	-		47 µF/6 V	CE 0219
C 246	-		100 µF/10 V	CE 0345
C 247	-		0,22 µF/40 V	CE 0479
C 248	-		15 µF/16 V	CE 0356
C 249,250	-		47 µF/6 V	CE 0219
C 251	-		15 µF/16 V	CE 0356
C 252	-		6,8 µF/25 V	CE 0488
C 253	Ceramic		22 nF/30 V	CK 4222
C 254	-		10 nF/30 V	CK 4101
C 255,256	Electrolytic		33 µF/10 V	CE 0353
C 257,258	-		15 µF/16 V	CE 0356
C 259	Ceramic		1,8 nF/400 V	CK 3181
J 201	15-pin socket			JJ 1509
J 202	48-pin socket			JJ 4803
L 201,202	Coil		100 µH	LJ 0021
L 203	Converter Coil			LB 0953

M 101	X-tal	2 ^{21} Hz	MB 0023
N 101	FREQ. WEIGHTING switch		NN 0128
N 102	EXT. FILTER switch		NN 0126
N 103	DETECTOR switch		NN 0132
N 104	-		NN 0126
N 105	TIME WEIGHTING switch		NN 0133
N 106	- -		NN 0127
N 107	RESET FUNCTION switch		NN 0127
N 108	RESET switch		OD 0330
	Knob for above switch		SN 0118
N 109	POWER switch		NN 0126
N 110	OPERATE switch		NN 0127
N 111	FSD switch		NN 0134
N 112	DISPLAY switch		NN 0135
N 113	SOUND INCIDENCE switch		NN 0126
P 101	Cermet	20 kΩ	PG 3210
P 102	-	10 kΩ	PG 3122
P 103	-	1 kΩ	PG 2117
P 201	-	100 kΩ	PG 4105
P 202	-	500 Ω	PG 1507
P 203	-	10 kΩ	PG 3122
P 204	-	20 kΩ	PG 3210
P 205	-	5 kΩ	PG 2519
P 206	-	5 kΩ	PG 2520
P 207	-	10 kΩ	PG 3122
P 208	-	500 Ω	PG 1507
P 209	-	100 kΩ	PG 4105

Q 101,102	Ze.	BZX79C4V7	4,4-5,0 V/0,25 W	QV 1380
Q 103	Si.	1N4150	50 V/400 mA	QV 0247
Q 106,107	-	1N4150	50 V/400 mA	QV 0247
Q 108	Ze.	1N4567	6,1-6,7 V/0,4 W	QV 0037
Q 109	Si.	5082-2811	15 V/20 mA	QV 5000
Q 110	-	1N4150	50 V/400 mA	QV 0247
Q 201-204	-	1N4150	50 V/400 mA	QV 0247
Q 205	Ze.	LM336	2,39-2,59 V	QV 0043
Q 206	-	1N4567	6,1-6,7 V/0,4 W	QV 0037
Q 207	-	BZX79B6V8	6,7-7,0 V/0,4 W	QV 1374
Q 208	Si.	1N4150	50 V/400 mA	QV 0247
Q 209	-	1N5817	20 V/1 A	QV 5004
Q 210	-	1N4150	50 V/400 mA	QV 0247
Q 211-214	-	1N5817	20 V/1 A	QV 5004
Q 215	-	1N4150	50 V/400 mA	QV 0247

R 101	Metal	1/4 W	1%	100 kΩ	RF 5100
R 102	-	-	-	110 kΩ	RF 5110
R 103	Carbon	-	5%	330 Ω	RB 2330
R 104	Metal	-	1%	88,7 kΩ	RF 4887
R 105,106	Carbon	-	5%	180 kΩ	RB 5180
R 107,108	-	-	-	100 kΩ	RB 5100
R 109,110	-	-	-	4,7 kΩ	RB 3470
R 111-115	-	-	-	47 kΩ	RB 4470
R 116	-	-	-	1,2 kΩ	RA 0048
R 117,118	-	0,1 W	-	47 kΩ	RA 0011
R 119	-	1/4 W	-	10 kΩ	RB 4100
R 120	Metal	-	1%	1,50 kΩ	RE 3150
R 121	Carbon	-	5%	4,7 kΩ	RB 3470
R 122	-	-	-	33 kΩ	RB 4330
R 123	-	-	-	5,6 kΩ	RB 3560

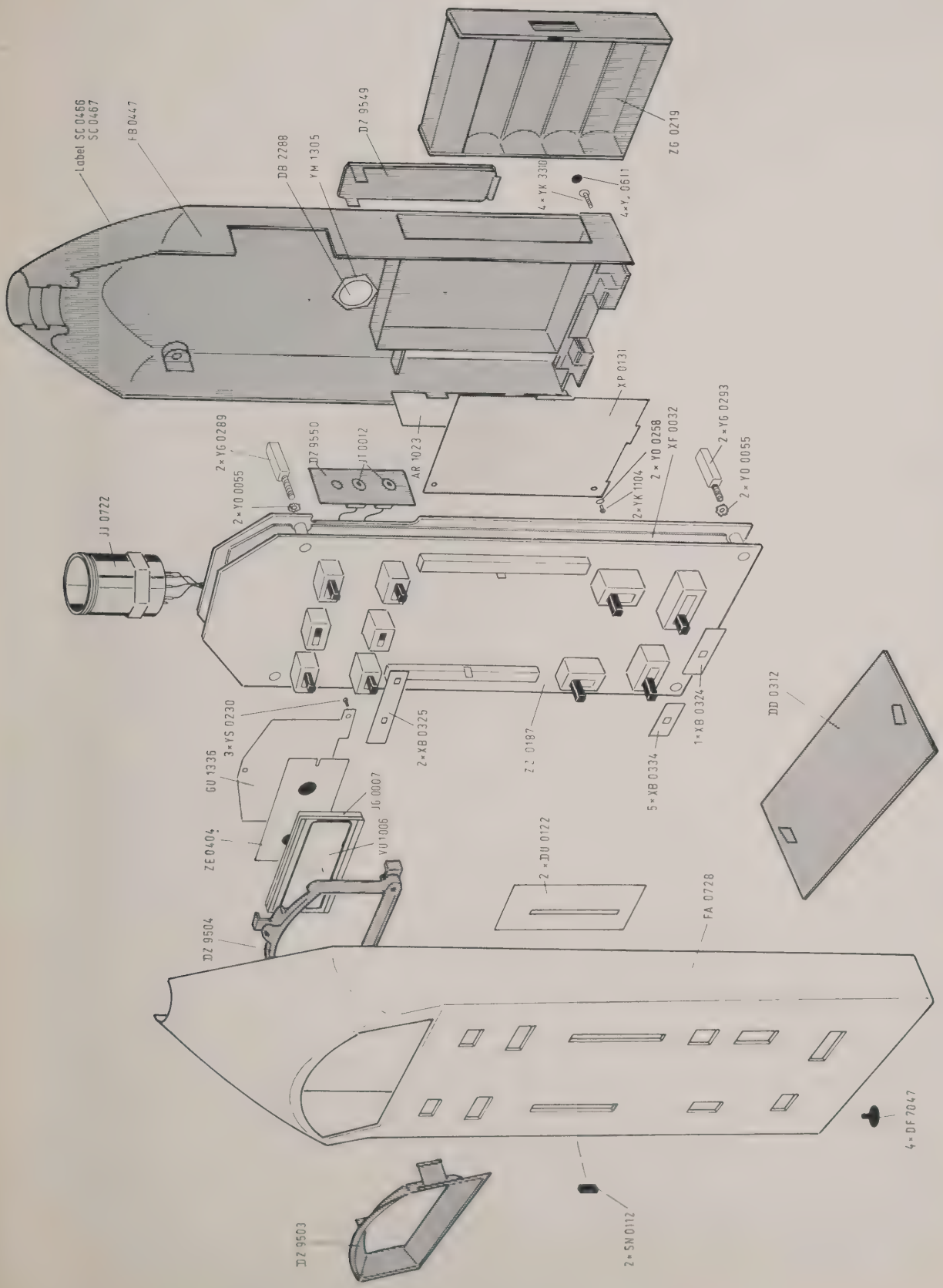
PARTS LIST

R 124	Carbon	1/4 W	5%	1,0 kΩ	RB 3100
R 125	-	0,1 W	-	39 kΩ	RA 0221
R 126	-	1/4 W	-	47 kΩ	RB 4470
R 127	-	-	-	5,6 kΩ	RB 3560
R 128	-	-	-	22 kΩ	RB 4220
R 129	-	-	-	3,3 kΩ	RB 3330
R 130	Factory selected				
R 131,132	Carbon	1/4 W	5%	47 kΩ	RB 4470
R 133-137	-	0,1 W	-	47 kΩ	RA 0011
R 138	-	1/4 W	-	47 kΩ	RB 4470
R 140	-	0,1 W	-	2,2 kΩ	RA 0020
R 202	Metal	1/4 W	1%	287 kΩ	RF 5287
R 203	-	-	-	2,87 kΩ	RF 3287
R 204	Carbon	-	5%	470 kΩ	RB 5470
R 205,206	-	-	-	22 kΩ	RB 4220
R 207	Metal	-	1%	100 Ω	RF 2100
R 208	Carbon	-	5%	22 Ω	RB 1220
R 210	Metal	-	1%	100 kΩ	RF 5100
R 211	-	-	-	40,2 kΩ	RF 4402
R 212	-	-	-	34,8 kΩ	RF 4348
R 213	-	-	-	80,6 kΩ	RF 4806
R 214	-	-	-	34,8 kΩ	RF 4348
R 215	-	-	-	100 kΩ	RF 5100
R 216,217	-	-	-	23,2 kΩ	RF 4232
R 218,219	-	-	-	2,87 kΩ	RF 3287
R 220	Carbon	-	5%	150 kΩ	RB 5150
R 221	-	-	-	47 Ω	RB 1470
R 222	Metal	-	1%	11,8 kΩ	RF 4118
R 223	-	-	-	100 kΩ	RF 5100
R 224	-	-	-	14,0 kΩ	RF 4140
R 225,226	-	-	-	110 kΩ	RF 5110
R 227	Carbon	-	5%	47 kΩ	RB 4470
R 228-231	-	-	-	47 Ω	RB 1470
R 232	Metal	-	1%	3,92 kΩ	RF 3392
R 233,234	-	-	-	10,0 kΩ	RF 4100
R 235,236	-	-	-	2,00 kΩ	RF 3200
R 237	-	-	-	150 kΩ	RF 5150
R 238,239	-	-	-	10,0 kΩ	RF 4100
R 240	-	-	-	3,24 kΩ	RF 3324
R 241	Carbon	-	10%	1,5 MΩ	RB 6150
R 242	Metal	-	1%	22,6 kΩ	RF 4226
R 243	-	-	-	17,8 kΩ	RF 4178
R 244	Carbon	-	5%	22 kΩ	RB 4220
R 245	-	-	-	10 kΩ	RB 4100
R 246	Metal	-	1%	20,0 kΩ	RF 4200
R 247	-	-	-	10,0 kΩ	RF 4100
R 248	-	-	-	5,90 kΩ	RF 3590
R 249	Carbon	-	5%	47 Ω	RB 1470
R 250,251	-	-	-	22 Ω	RB 1220
R 252	Factory selected				
R 253	Metal	0,5 W	1%	4,12 MΩ	RH 0042
R 254	-	1/4 W	-	11,8 kΩ	RF 4118
R 255	-	-	-	4,02 kΩ	RF 3402
R 256	-	-	-	2,87 kΩ	RF 3287
R 257	Carbon	-	5%	100 kΩ	RB 5100
R 25	-	-	-	5,6 kΩ	RB 3560
R 259	-	-	-	33 kΩ	RB 4330
R 260	-	1/2 W	10%	300 MΩ	RH 0912
R 261	-	1/4 W	5%	150 kΩ	RB 5150
R 262	-	-	10%	1,5 MΩ	RB 6150
R 263-265	Carbon	1/4 W	5%	22 Ω	RB 1220
R 266	-	-	-	68 Ω	RB 1680
R 267	-	-	10%	3,3 MΩ	RB 6330
R 268	-	-	5%	1,0 MΩ	RB 6100
R 269	-	-	-	10 kΩ	RB 4100
R 270	-	-	-	100 Ω	RB 2100
R 271	-	-	-	33 kΩ	RB 4330
R 272	Metal	-	1%	10,0 kΩ	RF 4100
R 273	Carbon	-	5%	22 kΩ	RB 4220
R 274	Metal	-	1%	28,0 kΩ	RF 4280
R 275	Carbon	-	5%	470 Ω	RB 2470
R 276	-	-	-	100 Ω	RB 2100
R 277	-	-	-	22 kΩ	RB 4220
R 278	-	0,1 W	-	2,2 kΩ	RA 0020

V 101	Op. Amp.	TL062	VE 0136
V 102	Silicon	BC212B	VB 0049
V 103,104	-	BC549B	VB 0580
V 105	8-bit Priority Encoder	4532	VD 2098
V 106	4-bit Full Adder	4008	VD 2003
V 107	8 × Buffer	74C244	VD 2607
V 108	A/D Converter	7570L	VD 3020
V 109	Comparator	311	VE 0054
V 110	Silicon	BF199	VB 0130
V 111	1 of 8 Decoder	1853	VD 5025
V 112	8-bit Processor	1802	VD 5009
V 113	Controller	MCA2866	VD 7002
V 114	RAM	1824	VD 5010
V 115	ROM	CD1833	VP 0501
V 116	8-Input NOR Gate	4078	VD 2040
V 201	Silicon	BC212B	VB 0049
V 202	Op. Amp.	TL062	VE 0136
V 204	- -	TL062	VE 0136
V 205	- -	TL072	VE 0146
V 206	- -	TL064	VE 0151
V 207	- -	741C	VE 0100
V 208	- -	358	VE 0134
V 209	Silicon	BC549B	VB 0580
V 210	-	BD131	VB 0593
V 211	-	BC549B	VB 0580

Z 101	Thickfilm	ZE 0446
Z 201	Hold Circuit	ZE 0386
Z 202	Preamplifier, Switch/Attenuator	ZE 0399
Z 203	RMS Detector	ZE 0410

Set of screened cables	AO 1310
8-pin IC socket	JJ 0817
15-pin socket	JJ 1510
16-pin IC socket	JJ 1631
18-pin IC socket	JJ 1811
20-pin IC socket	JJ 2017
24-pin IC socket	JJ 2407
28-pin IC socket	JJ 2801
40-pin IC socket	JJ 4003
Printed Circuit Board	XC 1934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SC 0467
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DZ 9549
ZG 0219
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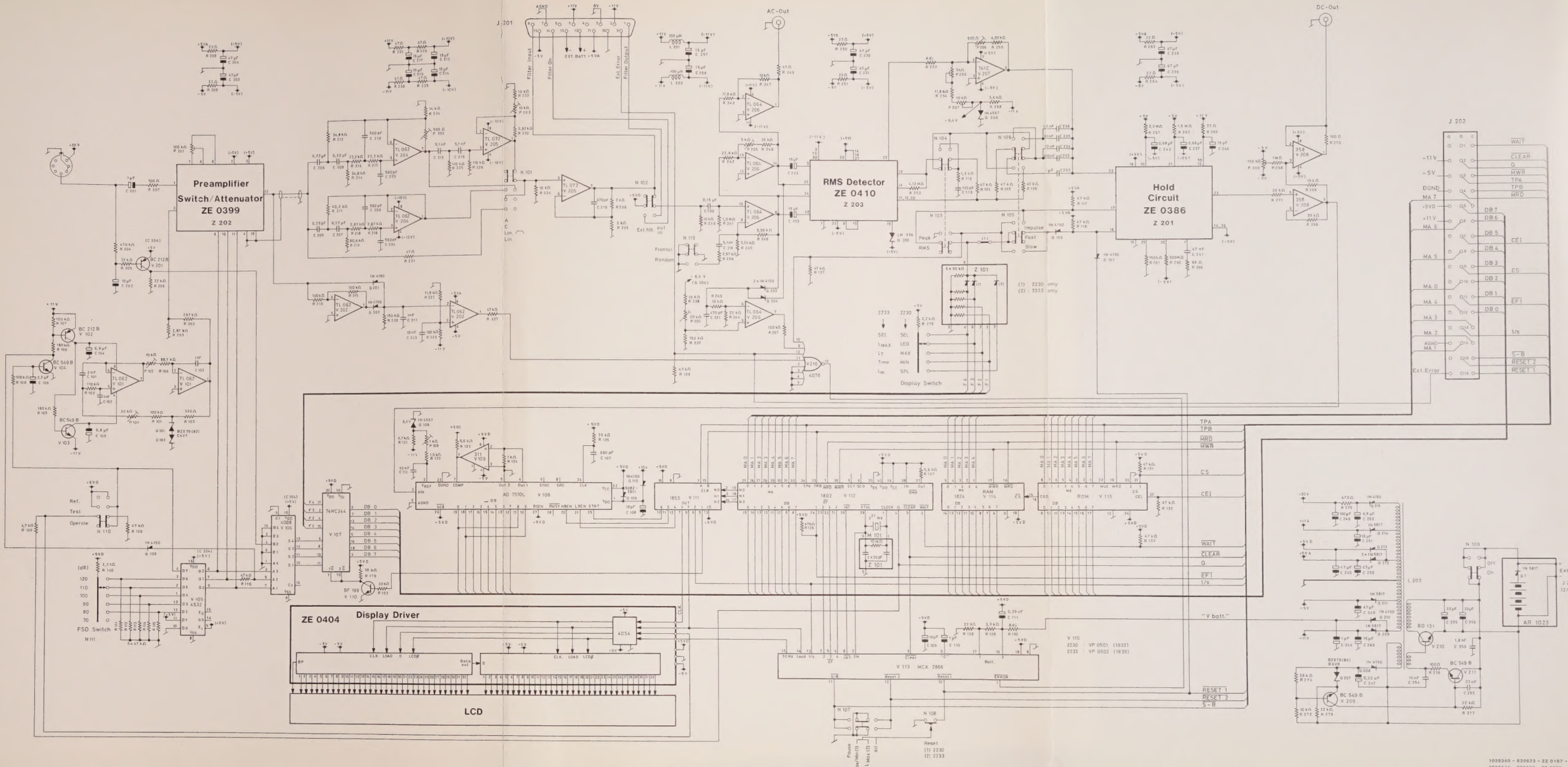
4 × YO 0611
XP 0131
2 × YG 0289
2 × YO 0055
DZ 9550
JT 0012
AR 1023
2 × YK 1104
2 × YO 0258
XF 0032
2 × YG 0293
2 × YO 0055
JJ 0722
3 × YS 0230
GU 1336
ZE 0404
VU 1006
JG 0007
2 × XB 0325
ZZ 0187
5 × XB 0334
1 × XB 0324
DD 0312
2 × DU 0122
DZ 9504
FA 0728
4 × DF 7047
DZ 9503
2 × SN 0112


Preamplifier
Switch/Attenuator
ZE 0399
Z 202
RMS Detector
ZE 0410
Z 203
Hold
Circuit
ZE 0386
Z 201
ZE 0404
Display Driver
LCD
Display Switch
FSD Switch
AC-Out
DC-Out
Filter Input
Filter On
Filter Output
Ext. Error
Ext. Batt. + 5 V
Ext. filt. out in
Frontal
Random
Peak
RMS
Impulse
Fast
Slow
Ref.
Test
Operate
Reset
Power
Ext. Batt.
AR 1023
"V batt."
WAIT
CLEAR
Q
MWR
TPA
TPB
MRD
CS
CE1
EF1
1/s
S-B
RESET 2
RESET 1
Ext. Error
LCD